

## **CLAIMS**

1. A dispensing system for dispensing material onto a substrate, the dispensing system comprising:
  - 5 a frame;
  - a support, coupled to the frame, that supports the substrate at a dispensing position in the dispensing system; and
  - 10 a dispensing head, coupled to the frame, that dispenses the material onto the substrate, the dispensing head including:
    - a motor unit having a first motor coupled to an output drive mechanism; and
    - a dispensing unit, removably coupled to the motor unit, having a material outlet from which the dispensing material is dispensed, the dispensing unit having a dispensing mechanism coupled to the material outlet and coupled to the output drive mechanism of the motor unit such that operation of the first motor causes the dispensing mechanism to dispense material through the outlet.
- 15 2. The dispensing system of claim 1, wherein the motor unit further includes a second motor operatively coupled to a lift plate to provide vertical movement of the lift plate, and wherein the dispensing unit further includes an adapter that couples to the lift plate to provide vertical movement of the dispensing mechanism to lower the dispensing mechanism towards the substrate for dispensing.
- 20 3. The dispensing system of claim 2, wherein the output drive mechanism includes a first gear and the dispensing mechanism includes a second gear disposed to engage the first gear, and wherein the first gear has elongated teeth and the second gear is constructed and arranged to move vertically when the dispensing mechanism is lowered while maintaining engagement with the elongated teeth of the first gear.
- 25 4. The dispensing system of claim 3, wherein the dispensing unit and the motor unit are constructed and arranged to provide kinematic mating between the dispensing unit and the motor unit.

5. The dispensing system of claim 4, wherein the dispensing unit includes a plurality of electrical contacts, and wherein the motor unit includes a plurality of electrical contacts for operatively coupling to the electrical contacts of the dispensing unit.

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6. The dispensing system of claim 5, wherein the dispensing unit includes electrical identification circuitry coupled to the plurality of electrical contacts that provides identification of characteristics of the dispensing unit.

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7. The dispensing system of claim 6, wherein the electrical identification circuitry includes a data storage element containing calibration data for the dispensing unit.

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8. The dispensing system of claim 7, wherein the dispensing unit includes an inlet pneumatic port and the motor unit includes an output pneumatic port that mates with the inlet pneumatic port of the dispensing unit to provide pressurized air to the dispensing unit.

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9. The dispensing system of claim 8, wherein the dispensing unit includes a syringe coupled to the dispensing mechanism to provide dispensing material to the dispensing mechanism, and wherein the syringe is constructed and arranged to move vertically when the dispensing mechanism is lowered.

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10. The dispensing system of claim 9, wherein the dispensing system is constructed and arranged such that the dispensing mechanism can be moved vertically over a range of movement, and wherein over at least a portion of the range of movement, the syringe does not move with the dispensing mechanism.

11. The dispensing system of claim 10, wherein the motor unit further includes a second output drive mechanism and the dispensing unit further includes a second dispensing mechanism.

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12. The dispensing system of claim 1, wherein the dispensing unit and the motor unit are constructed and arranged to provide kinematic mating between the dispensing unit and the motor unit.

5 13. The dispensing system of claim 1, wherein the dispensing unit includes a plurality of electrical contacts, and wherein the motor unit includes a plurality of electrical contacts for operatively coupling to the electrical contacts of the dispensing unit.

10 14. The dispensing system of claim 13, wherein the dispensing unit includes electrical identification circuitry coupled to the plurality of electrical contacts that provides identification of characteristics of the dispensing unit.

15 15. The dispensing system of claim 14, wherein the electrical identification circuitry includes a data storage element containing calibration data for the dispensing unit.

16. The dispensing system of claim 1, wherein the dispensing unit includes an inlet pneumatic port and the motor unit includes an output pneumatic port that mates with the inlet pneumatic port of the dispensing unit to provide pressurized air to the dispensing unit.

20 17. The dispensing system of claim 1, wherein the dispensing unit includes a syringe coupled to the dispensing mechanism to provide dispensing material to the dispensing mechanism, and wherein the syringe is constructed and arranged to move vertically when the dispensing mechanism is lowered.

25 18. The dispensing system of claim 17, wherein the dispensing system is constructed and arranged such that the dispensing mechanism can be moved vertically over a range of movement, and wherein over at least a portion of the range of movement, the syringe does not move with the dispensing mechanism.

30 19. A method of dispensing material onto a substrate using a dispensing system, the method comprising steps of:  
coupling a motor unit to the dispensing system, the motor unit having a motor with an

output drive mechanism;

coupling a dispensing unit to the motor unit such that a dispensing mechanism of the dispensing unit is operatively coupled to the output drive mechanism of the motor; and

operating the motor to cause material to be dispensed onto the substrate from the

5 dispensing mechanism.

20. The method of claim 19, wherein the output drive mechanism includes a first gear and the dispensing mechanism includes a second gear, and wherein the step of coupling the dispensing unit to the first motor unit includes engaging the second gear in the first gear.

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21. The method of claim 20, further comprising a step of vertically moving the dispensing mechanism toward the substrate while maintaining the motor unit and the dispensing unit in a fixed position.

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22. The method of claim 21, wherein the step of coupling the dispensing unit to the motor unit provides a kinematic coupling between the motor unit and the dispensing unit.

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23. The method of claim 22, wherein the step of coupling the dispensing unit to the motor unit includes a step of providing an electrical connection between the motor unit and the dispensing unit, and the method further includes a step of receiving data concerning characteristics of the dispensing unit over the electrical connection.

24. The method of claim 23, wherein in the step of receiving data, the data includes calibration information for the dispensing mechanism.

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25. The method of claim 19, further comprising a step of vertically moving the dispensing mechanism toward the substrate while maintaining the motor unit and the dispensing unit in a fixed position.

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26. The method of claim 19, wherein the step of coupling the dispensing unit to the motor unit provides a kinematic coupling between the motor unit and the dispensing unit.

27. The method of claim 19, wherein the step of coupling the dispensing unit to the motor unit includes a step of providing an electrical connection between the motor unit and the dispensing unit, and the method further includes a step of receiving data concerning characteristics of the dispensing unit over the electrical connection.

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28. The method of claim 27, wherein in the step of receiving data, the data includes calibration information for the dispensing mechanism.

29. A dispensing system for dispensing material onto a substrate, the dispensing  
10 system comprising:

a frame;

a support, coupled to the frame, that supports the substrate at a dispensing position in the dispensing system; and

15 a dispensing head, coupled to the frame, that dispenses the material onto the substrate, the dispensing head including:

a motor unit having a motor coupled to an output drive mechanism;

a dispensing unit having a material outlet from which the material is dispensed, the dispensing unit having a dispensing mechanism coupled to the material outlet; and

20 means for removably coupling the motor unit to the dispensing unit such that operation of the motor causes the dispensing mechanism to dispense material through the outlet.

30. The dispensing system of claim 29, further comprising means for vertically moving the dispensing mechanism toward the substrate while maintaining the motor unit and the dispensing unit in a fixed position.

31. The dispensing system of claim 30, wherein the dispensing head further includes means for providing a kinematic coupling between the motor unit and the dispensing  
30 unit.

32. The dispensing system of claim 31, wherein the dispensing head further includes means for detecting characteristics of the dispensing unit.

33. The dispensing system of claim 32, wherein the means for detecting 5 characteristics includes means for detecting calibration data of the dispensing unit.

34. The dispensing system of claim 29, wherein the dispensing head further includes means for providing a kinematic coupling between the motor unit and the dispensing unit.

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35. The dispensing system of claim 29, wherein the dispensing head further includes means for detecting characteristics of the dispensing unit.

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36. The dispensing system of claim 29, wherein the means for detecting characteristics includes means for detecting calibration data of the dispensing unit.